MARKET EFFECTS SUMMARY STUDY

FINAL REPORT

Volume 3

Submitted to:

Noah Horowitz, Project Manager
California Demand Side Measurement Advisory Committee

Submitted by:

Jane S. Peters, Ph.D.
Research Into Action, Inc.

Bruce Mast
Patrice Ignelzi
Pacific Consulting Services

Lori M. Megdal, Ph.D.
Megdal & Associates

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INTRODUCTION

This document is Volume 3 of the Market Effects Summary Study. The Market Effects Summary Study was commissioned by the Market Effects Subcommittee of the California Demand Side Advisory Committee (CADMAC) to evaluate the market effects of utility-based, demand-side management programs. The Summary Study reviews 15 studies undertaken by the Subcommittee between 1996 and 1998, at a total cost of over $2 million. The Summary Study team included Research Into Action, Inc., Pacific Consulting Services, and Megdal & Associates.

Volume 1 of the Summary Study presents an analysis of 13 studies. The analysis examines these studies relative to five functional areas selected by the Subcommittee and the Summary Study team. Volume 1 also includes a review of the Scoping Study. Volume 3 provides reviews of two studies, completing all 15 studies undertaken between 1996 and 1998. These final two studies were not completed in time to be included in the Summary Study analysis. They are reviewed here relative to the five functional areas.

A key document referenced throughout the Summary Study is the Scoping Study (Eto, Prahl, Schlegel, 1996). This study set the framework for assessing and reviewing the 15 studies. The Scoping Study was commissioned by the California Public Utilities Commission to address fundamental questions about market transformation. A key objective of the study was to propose an operational definition of market transformation based on assessing the degree to which utility programs had had market effects and had overcome underlying market barriers to energy efficiency in a lasting fashion. A review of the Scoping Study is included in Appendix A of Volume 1.

The 15 market effects studies addressed in the Summary Study were designed to provide the most extensive attempt to date to evaluate energy-efficiency programs for market transformation and market effects. The studies focused on demand-side management programs. Demand-side management programs are designed to save energy, not necessarily to transform markets. The context for the studies, therefore, was quite different from what future programs, since they are consciously designed to transform markets, will experience.

It is our expectation that market effects will be a focus of market transformation program evaluation, but we anticipate that the data sets for market transformation programs will be different from those for the demand-side management reviewed here. This will result in different analysis strategies and an improved ability to draw conclusions about market effects.

STUDIES REVIEWED

The two studies reviewed in Volume 3 are:

- PG&E Statewide Multi-Year Billing Analysis Study: Commercial Lighting Technologies (study number 2026P) was conducted by Quantum Consulting, Inc. for Pacific Gas & Electric (PG&E).

- *Residential Lighting Market Transformation Study (study number 3502)* was conducted by Decision Sciences Research Associations, Inc. for Southern California Electric (SCE).

MARKET EFFECTS SUMMARY STUDY

Final Report

APPENDIX C:

MULTI-YEAR BILLING ANALYSIS STUDY

Commercial Lighting Technologies

APPENDIX C

MULTI-YEAR BILLING ANALYSIS STUDY
Commercial Lighting Technologies

STUDY OBJECTIVES AND PROGRAM DESCRIPTION

In 1997/1998, Quantum Consulting conducted a multi-year billing analysis for Pacific Gas & Electric (PG&E)[1] concerning commercial lighting technologies. The objective of the study was to estimate the persistence of net load impacts from the Commercial Energy Efficiency Incentives (CEEI) Lighting Technologies Program during 1994. Two options were available in this program: the Retrofit Express (RE) Program and the Customized Incentive (Customized) Program. These net impacts included gross impacts, free ridership, persistence and market transformation effects. The study provided techniques that attempted to measure of each of these.

This study was commissioned as a multi-year billing analysis, not as one of the original CADMAC market effects studies. Yet, it did attempt to measure short-term market effects. Therefore, including this information in the Summary Study is appropriate. Nevertheless, due to its focus the Multi-Year Billing Study did not look at market barriers or market operation. It did not attempt to explain how or if market transformation occurred, nor did it attempt to provide market information for use in future programs. Nonetheless, it provided a thorough billing analysis that measured program effects and undertook a comparison analysis to estimate short-term market effects noted by nonparticipants (nonparticipant spillover). This latter technique might be used to measure market transformation. As a result, the summary of this study provided a useful addition to this report. Furthermore, though it did not purport to use the Scoping Study framework, nonetheless, a comparison of the study to the framework is included here to assist the reader in understanding how well a net load impact study meets the Scoping Study criteria.

COMPARISON WITH SCOPING STUDY FRAMEWORK

Market Effects

The Multi-Year Billing Analysis Study used important definitions and terms from the Scoping Study in a manner different than in the Scoping Study and the market effects studies. However, this study was an excellent impact evaluation that provided useful information about participant net savings, persistence, participant spillover and nonparticipant spillover. Yet, it was not, nor did it set out to be, a market effects study.

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[1] The study's title included "statewide." However, the report and the billing analysis were concerned only with these PG&E programs. The only evidence the review authors found of statewide analysis was 1) the statewide out-of-state comparison areas and 2) that these out-of-state studies had been obtained by Southern California Edison rather than PG&E.

It is important to understand the Multi-Year Billing Analysis Study's definition of market effects and terminology as opposed to those in the Scoping Study (and those being required of market effects studies). The report's authors defined total market effects as being all of the energy savings caused by high efficiency. Their definition was as follows:

Market effects = Market transformation effect + Naturally-occurring conservation (NOC)
= (Direct program effect + spillover + hidden MT effect) + NOC

These definitions clearly do not meet those in the Scoping Study. As quoted in Chapter 2 of this study, the Scoping Study clearly explained that the market effects differ from market changes because they are directly linked to market barriers and program interventions. The Multi-Year Billing Analysis Study did not study market barriers nor did it prove linkages to program interventions (attribution of effects to the program). As such, market change, not market effects, was measured. Measuring market effects requires an analysis of changes in market barriers; measuring market transformation additionally requires determining how sustainable the changes are in the operation of the market.

Using the Scoping Study definitions would create an equivalent definition as follows:

Market changes = Market effects + Naturally-occurring conservation (NOC)
= (Direct program effect + spillover + hidden MT effect) + NOC

The Multi-Year Billing Analysis did provide significant evidence of market changes and evidence of naturally-occurring conservation (from the comparison study). It did not, however, prove that the program caused the changes that were not due to naturally-occurring conservation.

STRENGTHS AND WEAKNESSES OF METHODOLOGIES

Strengths and Weaknesses of Evaluation Design

This was a comprehensive project. We believe that the authors carefully thought out alternative techniques for estimating just about every component of the analysis. Based on what the authors said they set out to do, the design was thorough and strong. This, however, does not mean that it was necessarily an appropriate approach for estimating market effects from market transformation programs. Rather, it was a solid retrospective design for evaluation of a DSM program. Using the term "market effects" does not make them so, as we discuss elsewhere.

There were so many reported results, there could have been clearer links between them. Some of the tables lacked complete documentation on how they were generated and how they related to earlier tables of results.

The primary study objective was to provide net load impacts for 1994 participants for subsequent years: 1995, 1996 and 1997. The study then examined five objectives to produce these net load

impacts. The authors referred to these collectively as "total market effects." While the delineation was clear and would have been a superior way to characterize impacts under the DSM evaluation regime, we do not agree that these were market effects. They were simultaneously too narrow to encompass market effects (ignoring decisions or market structure changes that might not manifest themselves in net reductions in energy use) and too broad to be labeled market effects (not all the impacts were causally linked to the program intervention).

The five stated study objectives used to arrive at net savings were:

1.	Gross load impacts produced by Statistically Adjusted Engineering (SAE) billing analysis model	Gross impacts
2.	Adjustments for persistence over time due to the failure and removal of measures	(-)
3.	Free riders, increasing FR over time accounting for those initial non-FR who were accelerated adopters	(-)
4.	Participant spillover	(+)
5.	Nonparticipant market transformation	(+)
	Adjusted for persistence	(-)
	Net Load Impacts	Σ

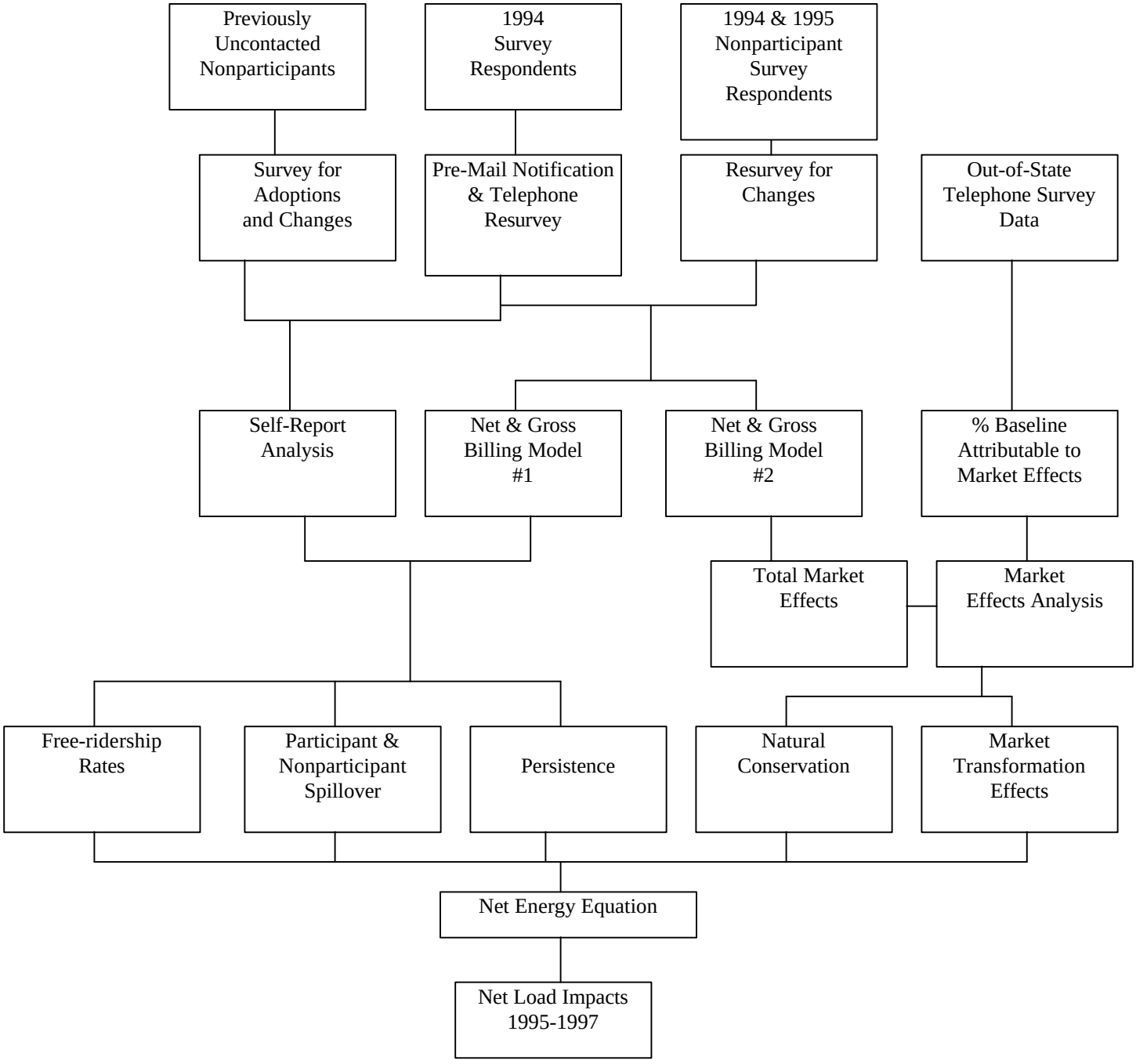
A summary of the analysis approach is presented in Table C-1.

The methodology for each of these steps is further described in the subsections below.

Gross Load Impacts and Persistence

Billing analysis was performed as a SAE analysis. The engineering estimates used to derive the SAE coefficient were the evaluation-based engineering estimates rather than the PG&E program ex-ante estimates. This was a wise selection. The evaluation-based estimate allowed the SAE coefficients for this study to provide the best realization rate given current knowledge, provided an up-to-date and easily derived estimate of savings, and did not double-count persistence loss when it was compared to findings from the 1994 annual impact evaluation. This latter consideration is seldom recognized as an important issue in persistence and retention studies. Whether the selection of the engineering priors was done with this in mind or not, it did accomplish this oft-difficult objective effectively.

Table C-1: Summary of Multi-Year Billing Analysis Approach



Original Source: Quantum Consulting, *PG&E Statewide Multi-Year Billing Analysis Study: Commercial Lighting Technologies*, Final Report, p. 4-2.

The first step was the creation of Baseline Model #1 consisting of the usage of nonparticipants (1994, 1995, and nonparticipants who had not been contacted previously) to include reported changes (such as employment changes, expansions and lighting additions). This model was used with 1993 pre-program usage data for the 1994 participants in order to predict the usage of 1994 participants if they had not participated in the program. Actual usage was subtracted from predicted usage for the 1994 participants to obtain the new dependent change variable. A simultaneous equation model was used to create Gross Model #1.

The simultaneous equal model had three separate parts:

Change	=	(1)	Post – Estimated post (beta-hat)
		(2)	Post – Predicted by business type & kWh from Baseline Model
		(3)	SAE model of 1994 participants and their reported changes

The decrease over time in the SAE coefficient represents the billing analysis' estimate of persistence loss. Yet, the lack of reasonable, statistically significant and stable persistence estimates led the Quantum authors to recommend the use of persistence estimates from the self-reports in the surveys. While we might ultimately agree with them, there are two reasons to take issue with this recommendation. First, the coefficients as reported (Exhibit 4.2.4-1) showed statistically significant SAE coefficients (realization rates) in all years for three of the six lighting technologies. (Most of the other technologies had very small sample sizes, which might account for their statistically insignificant findings.) This suggests that the authors meant that there was no statistically significant finding that the rates differed across the years. This simply means that one cannot reject the hypothesis that the effects persisted equally across the years, not that there were no reasonable findings. Second, there is no indication that the authors made any attempt to validate the self-reports for accuracy. The authors stated that this is a key weakness in using self-report data. Furthermore, we disagree with any rationale for using self-report data based solely on the finding that the results were more stable. It seems almost inherent that the self-reports would be more stable. Respondents were asked batteries of questions to track their decision-making processes. However, just because their answers appeared to make sense (i.e., did not bounce around much), they might not be accurate or reliable. This survey-based estimate was derived from the self-reported number of failures and removals divided by the number installed as recorded in the program database.

An alternative self-report calculation would have been to ask respondents what percentage of the measures installed through the program were still in place and operational. This would change the denominator for persistence from those recorded in the program database to the number actually installed through the program (self-reported). If the program database were subject to error, this could provide a more accurate persistence estimate. It also would ensure that

persistence losses would not be double-counted when compared to the first-year impact evaluation.

This study also took a very conservative view of persistence, by defining it as the persistence of the actual measures installed in the program. A less conservative approach could examine the persistence of savings. This would include information as simple as whether or not a bulb is replaced by a bulb identical to the program measure. If it is, the savings are maintained. For this short-term persistence study, the two definitions appeared to have provided identical results.

In a longer-term persistence study, however, the differences would be substantial. For example, according to the first definition, when measures have completed their useful lives, their persistence would be zero. In addition, one would assume that if the measure were replaced by identical equipment induced by program participation then these savings must be counted as participant spillover. According to the second definition, replacement of that same fixture would constitute persistence of savings that may go on well beyond the measure's useful life. In this second case, participant spillover would be measured only as additional energy savings from other adoptions due to program participation (converting other fixtures, more efficient equipment when adding new equipment, etc.).[2] The study noted that if failed or removed equipment have been replaced by equipment of equivalent or higher efficiency, then post-period usage would not have increased. They cited this as a problem for their billing analysis persistence estimate (p. 3-3). However, this is not a problem in a billing analysis persistence estimate based upon the second definition of persistence of savings. It should be recognized, however, that differentiating between specific equipment failure or removal rates is critical to a technology lifetime assessment study, which is a different type of study in the retention/persistence class of studies.

Free Riders

Two methods were examined to estimate free ridership: a survey-based self-reported approach, and an Inverse Mills Ratio with interactive effects.

The Inverse Mills Ratio was calculated from the results of a probit model of participation that included 300 participants and 831 nonparticipants. Responses to market barrier questions, customer business activity, building characteristics, and organizational characteristics were tracked. The approach seems to have been applied in a way that captures the spirit of the Goldberg & Train treatise (cited on p. 4-17). However, it would have been more accurate to address the endogenous link between participation decision and savings amount if the probit model used to calculate the Mills Ratio had incorporated estimated savings directly rather than using what may or may not have been good proxies for savings (e.g., facility size). The authors might have chosen the proxy alternative to bypass the problem that nonparticipant data often do

[2] This second definition was used in *Boston Edison Company's 1997 Demand-Side Management Persistence Study* conducted by Megdal & Associates.

not include savings estimates, leaving analysts to fill the gap in one of two ways: set nonparticipant savings estimates to zero or adapt some other estimates (e.g., the engineering estimates applied to participants for the same installation types).

The Mills Ratio analysis had several weaknesses: 1) it provided statistically significant estimates of free ridership only for fluorescents, 2) it did not include the largest customers, 3) it had smaller sample sizes than the survey-based approach (although they were rather sizable) and 4) it had potential for three sources of error, one in each step of the process. Given this, the study recommended using the self-reported free ridership estimates. We do not concur that counting the number of error types may be a particularly robust way of choosing among approaches. Though there may be only two types of errors with self-reports (wrong answers and nonresponse bias), each of these can be formidable.

The free ridership estimates from the survey also incorporated "when" into their estimates. This allowed free ridership from participants who were accelerated adopters to be taken into account. For example, participants who would have installed high-efficiency without the program but would have done so two years later, would not have been considered free riders in the first two years but would have been three and more years after participation. The use of a discrete choice selection model (predicting participation in the Probit model rather than predicting when participation would occur) did not allow the statistical and billing analysis approach to capture this changing free ridership over time.

Market Effects Analysis

The authors' goal for this step was to add nonparticipant market transformation to participant net savings to obtain total net program impact. They did this using results from a survey of commercial customers in Georgia that inquired about lighting installations and high-efficiency adoptions. The team also attempted to address market effects within the scope of what was being done. Unfortunately, since this was not a true market effects study, they were unable to prove market effects. They also used some of the terminology inappropriately. (This is more fully discussed in the Comparison to Scoping Study Framework section.) Nevertheless, the techniques employed were appropriate for the authors' original goals and gave information about techniques that could be used in comparison analyses in future market transformation analyses.

Finally, the authors took self-reported adoptions from 12 surveys to produce estimates for PG&E's commercial population. This used nonrebated adoption rates of participants and nonparticipants leveraged with data from the entire tracking system and estimated to represent PG&E's total commercial population. This was a multistep process using adoption rates from the surveys, estimates of fixtures per measure adopted, and kWh savings per measure. Savings per fixture estimates were derived from Gross Model #1.

A lower bound of this market transformation effect was obtained as the self-reported spillover from the surveys.

An initial, but unsuccessful, approach to achieve this objective was the use of billing analysis to create the estimate of the market transformation effect. This was to remove the lighting replacements in the change variable. The authors hypothesized that this alternative specification would cause lighting changes to be reported in the business type intercepts and the pre-usage parameter estimates of the base model. Yet, results from this billing analysis approach were not stable over time and changed by large, inexplicable amounts. By contrast, the self-reported survey approach produced stable estimates based on 12 surveys and a very large sample size of over 9,000 observations.

Market Transformation Effects Analysis

As defined by the Quantum study authors, total market effects minus naturally-occurring conservation produced the program's market transformation effects. These included direct effects, spillover and hidden market transformation effects. We must state that we consider this just a component of market change unless program attribution can be proven. If it can, then the latter case indeed could be considered market effects. Market transformation requires an even greater preponderance of evidence and some measure of potential sustainability. Measuring naturally-occurring conservation is the most difficult part of measuring these components. The authors chose to examine two potential baselines: an out-of-state control group, and nonparticipants who reported that the program had not influenced their decisions. However, the study recognized difficulties in these two approaches. For instance, the out-of-state group that did not have a DSM program might not be a perfectly-matched control group. On the other hand, the nonparticipant population that reported no program influence could have been affected by hidden market effects (e.g., vendor stocking practices). In addition, an important problem with using a nonparticipant baseline that was not acknowledged in the report is that nonparticipants, especially those who have not heard about the program, do not occur at random but in fact hold a large self-selection (i.e., are a biased population). This has been reported extensively in the free ridership literature.

Market transformation effects were estimated using both baselines. The authors recommended using the out-of-state comparison approach. They did so, while recognizing that the hidden market transformation effects in the nonparticipant group caused this estimate to be a lower bound of the program's market transformation effects.

The Georgia survey was chosen for the out-of-state comparison. New York had a program similar to CEEI until 1993; its survey results showed some evidence of the program's effect and its market transformation effects. The results for the Louisiana program were much lower than for Georgia's, making Georgia the mid-ground. Given this and the closer correspondence

between the business size and building size in the Georgia survey and PG&E's commercial population, Georgia was selected as the out-of-state comparison group.

By using Georgia as a baseline the authors achieved 10 times the level of market transformation then they would have if they had used an estimate based upon self-reported spillover from the surveys. Therefore, they estimated that two-thirds of nonparticipant installations were due to the program, primarily as a result of hidden market transformation effects. The lower bound estimate created by using the nonparticipant baseline produced an estimate that 10% of nonparticipant installations and half of all adoptions of high-efficiency equipment were due to the program.

STRENGTHS AND WEAKNESSES OF DATA COLLECTION PROCEDURES

Assessment of Data Completeness

Sampling Design

The Multi-Year Billing Analysis Study was able to draw upon several completed surveys about the commercial lighting market. Information was used from prior surveys of participants and nonparticipants conducted for the annual impact evaluations of the CEEI program for 1994, 1995 and 1996. Then several of the groups (1994 participants, 1994 nonparticipants and 1995 nonparticipants) were re-surveyed to obtain current information to be used to address persistence, changes and spillover. An additional survey of nonparticipants also was undertaken to provide a larger nonparticipant sample.

Out-of-state comparisons were made with four surveys conducted outside of this study. This was an excellent example of how prior work can be used effectively to stretch limited resources. These four surveys consisted of three commercial lighting surveys conducted in 1997 by Southern California Edison Company (SCE) of customers in Georgia, Louisiana and New York, and an out-of-state survey conducted by Xenergy as part of the Commercial Lighting Market Effects Study.

The three SCE surveys were designed to represent the commercial population of California. This was achieved by surveying commercial establishments in Georgia, Louisiana and New York with quotas based upon business type and size (by energy usage) whose distribution (by business type and size) matched that of California's commercial population. This survey design allowed the authors to make straight comparisons instead of using a complicated weighting design but still ensured comparability.

Table C-2 presents a summary of the data sources used in this study.

Strengths

- An excellent use of prior program evaluation surveys, and re-surveying. This was complemented by the fact that the out-of-state comparison groups were obtained cost-effectively by using three recent out-of-state surveys on the same market for Southern California Edison.

- Very good documentation of how each survey provided data for the various components of the analysis.

Weakness

- One of the great strengths of this study also created a wonderful missed opportunity. Using prior surveys meant that this study was limited by what those studies collected. The re-surveys conducted in this study asked six market barrier questions. Asking these same questions of the control group, (the Georgia customers), and comparing their responses (with comparatives between program participants, PG&E territory nonparticipants, and out-of-state) would have provided key evidence supporting the program's causality of effects and measurement of market barriers.

Table C-2: Summary of Multi-Year Billing Analysis Approach

SURVEY	RE-SURVEYED	SAMPLE SIZE	CONTROL GROUP
1994 participants	✓	300	
1994 nonparticipants	✓	240	
1995 participants			
1995 nonparticipants	✓	239	
1996 participants			
New survey of nonparticipants		352	
Out-of-State Comparisons			
Georgia		778	✓
Louisiana		500	
New York			

Out-of-State Survey -- Xenergy CI Market Effect Study

Assessment of Data Collection Procedures

The data collection procedures appear to meet industry standards.

SUSTAINABILITY AND LASTINGNESS

Critiques of the Evaluation's Evidence and Conclusions with Regard to Sustainability

Since this study was not a market effects study *per se*, it did not discuss, define or analyze sustainability. The study did, however, claim substantial market transformation effects from 1994 through 1997 when the Georgia study was used as the comparison baseline. Yet, we believe that without analysis of the hypothesized market barriers, analysis to identify the market barriers, and a preponderance of evidence of attribution to program intervention, this claim cannot be substantiated; they did not prove that the difference in adoption (and, therefore energy usage) of high-efficiency lighting between Georgia and PG&E's service territory was due to PG&E's CEEI program. The difficulty of attribution was also complicated by the fact that there were numerous utility programs and nonutility promoters of energy-efficient lighting in California, and proving that this program caused these impacts would require significantly more research. Since they did not prove market effects (effects to the market attributable to the program), there is not a basis for sustainability analysis.

OPPORTUNITIES FOR USE OF THE MARKET EFFECTS EVALUATION

Strengths and Weaknesses of Program as Market Transformation Program

The study claimed substantial market transformation effects from 1994 through 1997 when using Georgia as the comparison baseline (see the above discussion concerning claimed *versus* actual proved results). However, some components of the analysis did not provide confidence in the authors' claims. Section Five of the Multi-Year Billing Analysis Study compared the PG&E and out-of-state samples. In that section, there are 12 market transformation comparison indicators. Of these, seven were positive, three negative and two showed no effect. In addition, several of the positive indicators were only marginal. Given the large market transformation effects claimed from the net load impact calculations, we would have expected the differences in these market transformation indicators to be greater.

Further evidence of market transformation impacts of the commercial lighting program(s) was examined in the Commercial Lighting Market Effects Study for PG&E and San Diego Gas & Electric as performed by Xenergy and Easton Consultants. This market effects study was covered in an earlier chapter of this report. As the two studies view the same market in very different manners, examining the two studies together may provide additional insights into this market.

Potential for Future Use of New Market Transformation Evaluation Techniques Tested

The steps used to develop comparable estimates to billing analysis from out-of-state survey results can be replicable and useful in future market transformation measurements. This was accomplished using adoption rates, number of fixtures and usage rates. There may be some changes necessary if the techniques are employed for true market transformation efforts rather than in a DSM program. For example, the comparisons might still be done, but adoptions might be examined rather than usage (which was estimated from adoptions in this study). Depending on the nature of the current market transformation program being assessed, the question of free riders no longer may be relevant. At this time, we do not know under what circumstances in market transformation efforts it will be important to determine which actors performing new behaviors are doing so due to direct intervention efforts, indirect influences, or naturally-occurring conservation. Rather than using this information as the basis for utility incentives, might this information be needed instead to inform the sustainability analysis? (The techniques used in this study may be applicable. Yet, before this can be decided, the questions may have to be further defined depending on the kind of market transformation effort being examined.)

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APPENDIX D:

SCE HIGH QUALITY COMPACT FLUORESCENT LAMP STUDY

APPENDIX D

SCE HIGH QUALITY COMPACT FLUORESCENT LAMP STUDY

STUDY OBJECTIVES AND PROGRAM DESCRIPTION

Decision Sciences Research Associates, Inc. (DSRA) conducted this residential lighting baseline study on behalf of Southern California Edison. While the study was nominally linked to the 1996 LightSaver program, the study was primarily forward-focused. In the words of the report: "The goal of this project was to collect data to use as a baseline for a multi-year measurement effort focused on the market for residential lighting products. ...Considering the scope of the retail lighting market, our plan was to collect observations in advance of market transformation interventions. Specifically, we focused on characterizing the retail sales environment for residential lighting products and measuring customers' knowledge, attitudes, and practices pertaining to shopping for and using various residential lighting technologies." However, from subsequent conversations with SCE staff, it became apparent that the study was originally intended primarily as a baseline study for future impact evaluation and market retention studies for the 1996 program. The shift in emphasis to market transformation occurred after the study was already underway.

The description of the program itself is somewhat vague. According to the report: "Edison's 1996 LightSaver program provided funds to manufacturers to be used in unspecified amounts for combinations of advertising, sales promotions, and sales training, as well as reduction in the retail price of program-qualifying compact fluorescents.[3] In addition, Edison's program staff prepared a press release that resulted in a program launch announcement that was submitted to Southern California media outlets." Lights of America was apparently the sole participating manufacturer. Several retail outlets were also classified as participants but it was not clear from the report if their participation was the direct result of contact with the program or the indirect result of their ongoing relationship with Lights of America. It was also not clear from the report what direct role the program played in preparing and disseminating program-specific point-of-purchase information. The report also gave no indication of the nature or extent of prior-year utility initiatives to promote energy-efficient residential lighting technologies.

[3] Program-qualifying CFL included two “screw-in” models with a high power factor, good color rendition, low total harmonic distortion, and instant-on electronic ballasts.

SUMMARY TABLES

Table D-1: Summary of Study Features

Title:	Residential Lighting Market Transformation Study
Project Number:	3502
Sponsoring Utility:	Southern California Edison
Contractor:	Decision Sciences Research Associates, Inc. (DSRA)
Sector:	Residential
End-Use Elements Examined:	Lighting
Program Year(s):	1996
Program Intervention(s):	Manufacturer rebates for wholesale discounts, product packaging, and point-of-purchase materials

Table D-2: Key Study Results

BARRIERS ADDRESSED

BARRIERS	ACTORS AFFECTED	BARRIER DESCRIPTION	PROGRAM SUCCESS IN REDUCING MARKET BARRIER
High first cost	Consumers	None provided	Baseline measurements only
Product availability (sic)	Consumers	None provided	Baseline measurements only
Performance uncertainty	Consumers	None provided	Baseline measurements only
Information search	Consumers	None provided	Baseline measurements only
Hassle costs	Consumers	None provided	Baseline measurements only
Asymmetric information (about savings)	Consumers	None provided	Baseline measurements only

Table D-3: Key Study Results

NEW DATA COLLECTED

DESCRIPTION	COLLECTION METHOD	COLLECTION PERIOD
Type and amount of lighting products stocked; inventories of product by manufacturer, model, and price, marketing and display features	118 Retail store inspections at 30 participating and nonparticipating store locations	1996Q4-1997Q1, 1997-1998
Where CFBs were installed; their operating hours; future plans to use CFBs; how people learned about and selected CFBs	Phone interviews of 521 customers who purchased program CFBs and returned program response cards	
Knowledge, attitudes, and practices associated with shopping for and using residential lighting products	Random-digit-dial phone survey of 515 residential customers	

COMPARISON WITH SCOPING STUDY FRAMEWORK

As noted previously, the research design for this study was developed to support future impact evaluation rather than market transformation studies. This may explain why, except for some shared nomenclature, the links between the Scoping Study and this research approach are somewhat tenuous. In fact, the organization of the report, in which the discussion of the research hypotheses and potential market barriers is reserved for the last chapter, suggests that the connections between the research approach and the Scoping Study framework might have been established after the research was complete.

Market Effects

Since the study research design was not originally oriented toward market transformation, the strategy for benchmarking future market effects does not reflect the intent of the Scoping Study. At issue is the lack of any documented connection between the hypothesized market effects and current market barriers. Thus any future study that documents changes in the benchmarked parameters would have some difficulty in arguing that the observed changes reflect reductions in significant market barriers.

Market Barriers

A discussion of the full list of barriers considered is limited to the following sentence: "We identified and measured residential lighting barriers including: high first cost, product availability, performance uncertainty, information search, hassle costs, and asymmetric information (*about savings*)." Only three barriers are mentioned anywhere else in the report and two of the three barriers discussed are not among the full list of six barriers. The report discusses its findings relating to understanding prices, product availability, and customer awareness, claiming that availability of compact fluorescent bulbs is not a significant barrier, while first cost and customer awareness are. In light of concerns about the rigor of the analysis, evidence either for or against these findings must be considered less than compelling.

Sustainability and Lastingness

This issue was not directly addressed in the evaluation. One could interpret the study as providing a tangential discussion of sustainability in its discussion of evidence that the market is being transformed. The authors cite the following indicators as potential evidence of market transformation:

- Expansion of high quality compact fluorescents into new retail niches (e.g., Grocery stores and convenience outlets)
- Replacement of conventional lighting types with cfbs on shelves dedicated to lighting products
- Shifts in retail point-of-purchase displays and retail advertising from convention lighting to high quality compact fluorescents or other types of new lighting.

Comparison to Other Market Transformation Frameworks

Since the study was a baseline study, comparison to any particular market transformation framework is somewhat limited.

Recommendations for Modifications to Scoping Study

The study provided no recommendations for modifying the Scoping Study and we find that no recommendations for modifications based on this study are warranted.

STRENGTHS AND WEAKNESSES OF METHODOLOGIES

Strengths and Weaknesses of Evaluation Design

Our concerns about the evaluation design fall into three general categories: concerns about the conceptual framework that guided the design; concerns about the specifics of the data collection plan; and concerns about the analysis and reporting.

Concerns about the Conceptual Framework

As alluded to above, the evaluation design displayed only a tenuous connection to the Scoping Study framework. In and of itself, this lack of connection would not be a significant problem. However, the report established virtually no link between the study design and the design of the 1996 LightSaver program, nor with the expected design of any future market transformation intervention in the residential lighting sector. Finally, the study made no reference to any other research that has been conducted in this sector. The net result was an evaluation that appeared to be conducted in a vacuum. The study provided no context or "story" to motivate its design choices. Study results would have been much more compelling had the study provided, at a minimum, a fuller elaboration of the following:

- Existing documented barriers in the residential lighting sector, based on other research
- Additional motivation for hypothesized barriers expected to exist in the market
- A more complete description of market conditions and dynamics that makes the existence of these hypothesized barriers likely
- A full description of current and any anticipated program interventions in the market
- An explanation of the relationship between those interventions and known or hypothesized market barriers
- A description of the process by which program interventions, acting on known or hypothesized market barriers, would produce the hypothesized market effects
- Links between the set of hypothesized market effects and the data collection and analysis plan

No attention was paid to potential upstream market barriers or market effects. The study might well have benefited from interviews with purchasing agents and sales staff for retail outlets, as well as manufacturers and wholesalers. Alternatively, the study needed to provide enough context, in the form of documented knowledge of existing upstream market conditions and barriers, that would support the decision to focus exclusively on downstream barriers and effects.

Concerns about the Data Collection Plan

A lack of systematic data collection planning is evident in the phrasing of a number of survey questions. For example, respondents who were asked to mention the type of lighting supplies they had bought were given the following options: Regular (incandescent light bulbs); Fluorescent tubes; Lighting fixtures (wire-in); Table or floor lamps; Energy-efficient lighting equipment; or Other specialty lighting. These categories are neither mutually exclusive nor exhaustive. As a further example, respondents who expressed dissatisfaction with fluorescent lights were asked what kind of lighting they would prefer in its place. Among the alternatives offered was "Modern or some other type of fluorescent lighting." In general, we found enough instances of vague questions and biased or loaded terminology to raise concerns about the reliability of some of the results. We would have reservations about including some of the identical questions in any follow-up survey. However, without their inclusion as originally worded, any conclusions relating to changes in responses over time are compromised.

Concerns about the Analysis

Our concerns with the analysis and reporting are threefold. First, the analysis relies exclusively on simple one-way tabulations of results. Though the survey captured a fair amount of demographic data, no cross-tabulations were documented between lighting-related data and demographic data. The authors made no attempt to explain findings by relating them to underlying factors. Such cross-tabulations would have helped the reader assess whether the results appear plausible, whether they are consistent with research results from other sources, or whether they represent a new and unusual finding or one that is counter-intuitive.

Our second concern with the analysis and reporting is that conclusions occasionally appear to be unsupported by the data. The most striking example is the conclusion that few consumers expressed dissatisfaction with compact fluorescents in use at their homes. This conclusion is based on an 80.5% satisfaction rating for compact fluorescents, despite the fact that the comparable rating for halogens was 93.6% and the satisfaction rating for (standard) fluorescent lighting was 94.5%. A second example is the conclusion that most respondents underestimate the amount of electricity used for lighting in the average home, based on the authors' assertion that lighting is on average the greatest use of electricity and on the fact that most respondents ranked HVAC and refrigeration as the highest consumption end uses. Our reading of the literature on end-use consumption is that HVAC and refrigeration represent higher consumption end uses in the residential market.

Our final concern with the analysis and reporting is that reported percentages are virtually never supported with documentation of the number of responses that serve as the basis for the percentage calculations. A detailed review of survey tabulations in the appendices reveals that many of the questions of most potential value have just a hand-full of responses. For example, percentages for different reasons for purchasing compact fluorescent bulbs are based on only 60

responses. Results from questions relating to interactions with sales staff are based on only ten responses. Conclusions based on these and similar results with low response rates should be treated with a degree of skepticism.

Comparison to Economic Framework

The study shows a strong economics influence in its design and analysis. For example, the study devotes considerable survey time to measuring respondents' detailed knowledge of pricing issues, including purchase and operating costs of energy-efficient and standard lighting technologies, cost of electricity, and energy consumption due to household lighting. Furthermore, the study asserts the importance of first cost as a market barrier without actually documenting its importance relative to other purchase considerations. Implicitly, then, the study seems to consider consumers as rational, self-interested, utility maximizers, albeit uninformed ones.

STRENGTHS AND WEAKNESSES OF DATA COLLECTION PROCEDURES

Assessment of Data Completeness

This study involved three primary data collection efforts:

- 118 Retail store inspections at 30 participating and nonparticipating store locations
- Participant phone interviews of 521 customers who purchased program compact fluorescent bulbs and returned program response cards
- Baseline phone survey of 515 residential customers, selected using random-digit-dial methods

The retail store inspections were used to record the type and amount of lighting products stocked; inventories of product by manufacturer, model, and price; and marketing and display features. The participant phone interviews recorded where compact fluorescent bulbs were installed; their operating hours; future plans to use compact fluorescent bulbs; and how people learned about and selected compact fluorescent bulbs. Finally, the baseline phone survey recorded levels of knowledge and attitudes toward lighting technologies, and customers' practices associated with shopping for and using residential lighting products.

From the perspective of data completeness, the most glaring omission was the lack of any survey data from retailers, wholesalers, or manufacturers. Thus the study provides no insight into potential upstream market barriers that restrict the supply of reasonably priced compact fluorescent bulbs. In the absence of any "story" of the lighting market's function, the lack of upstream survey data cannot be explained.

Of the three data collection efforts pursued, the in-store data are arguably the most complete. The site visit sample design incorporated multiple visits to stores and included multiple locations for selected chains. The authors were thus able to document variations in stocking and displays practices among stores of the same chain and changes in retail stocking and display practices over time. This thoroughness added considerable credibility to the analysis of the lighting retail sector. However, one gets the impression that considerable specificity in the data was ignored in the report.

The completeness of the baseline survey data is generally satisfactory, although we noted some problems. Random-digit-dialing is generally a sound strategy for sampling residents in a way that does not inadvertently exclude or over-represent any subpopulation. One can thus be reasonably confident that baseline results are free of sample bias. The overall number of completed baseline surveys (515) is generally considered sufficient to produce robust results. However, as described above, many of the questions of most potential value have just a hand-full of responses. The completeness of the data collection would have been greatly enhanced if a sufficient number of surveys had been conducted to produce reasonably robust results for questions that were targeted to small subgroups of the sample.

Assessment of Data Collection Procedures

Every indication in the report suggests that data collection procedures were consistent with industry standards. Phone surveys were conducted using a CATI system. Field staff responsible for collecting in-store data used discrete recording methods that enabled them to collect the needed information without drawing the attention of store managers or other customers. Thus the study avoided introduction of sampling bias that might have occurred had the field staff only visited stores with the permission of store management.

SUSTAINABILITY AND LASTINGNESS

This issue was not addressed in the evaluation.

OPPORTUNITIES FOR FUTURE USE OF THE MARKET EFFECTS EVALUATION

Strengths and Weaknesses of the Residential Lighting Programs as Market Transformation Programs

Since no attempt was made to link study findings to prior-year program interventions, no conclusions can be drawn relating to their strengths and weaknesses as market transformation programs.

Potential for Future Use of New Market Transformation Evaluation Techniques Tested

No new market transformation evaluation techniques were tested as part of this evaluation. Furthermore, though the study purported to be a baseline study, we do not believe it provides a sufficient assessment of the residential lighting products market. Additional work to fully characterize the market would be required.